

April 28, 2021

Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street, SW
Washington, D.C. 20554

Re: Promoting the Deployment of 5G Open Radio Access Networks (GN Docket No. 21-63)

Ms. Dortch:

Dell Technologies Inc. ("Dell Technologies") respectfully submits this Comment Letter in response to the notice of inquiry issued by the Federal Communications Commission (FCC or Commission) regarding the potential of open and virtualized Radio Access Networks in securing America's communications networks and the communications supply chain, and in driving 5G innovation. Dell Technologies supports the Commission's efforts to accelerate the development and deployment of Open Radio Access Networks (Open RAN), which is integral to the technological advancement, integrity, and security of our Nation's and the global supply chain ecosystem.

State of Development and Deployment of Open RAN Solutions

Current Standards and Specifications.

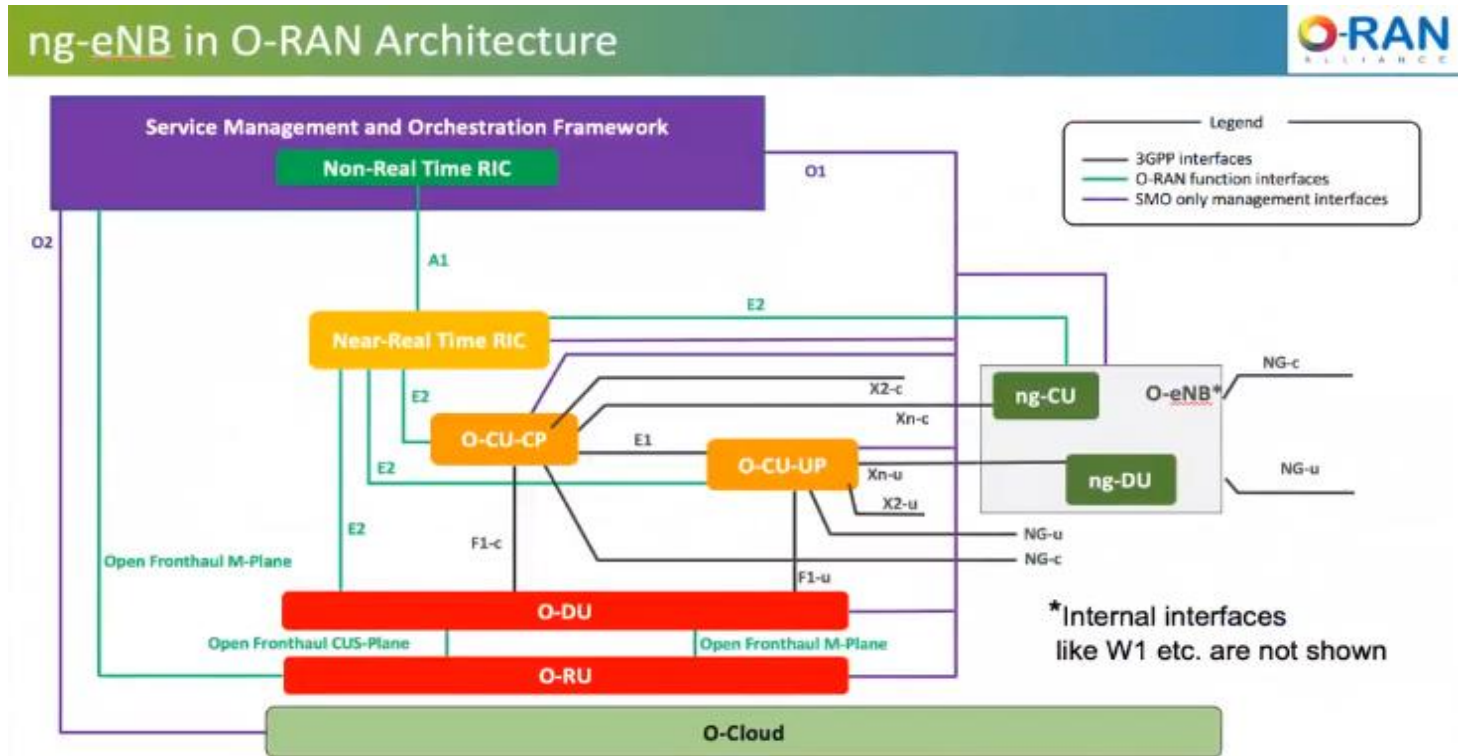
Since 3GPP defined disaggregation RAN into RU, DU and CU in Release 15 with multiple splitting options, the O-RAN Alliance was formed in 2018 to lead the charge on definition of multiple interfaces and protocols for operation of this composable RAN.

The O-RAN Alliance consists of several categories of participants, including Telecom Operators, incumbent NEPs, and variety of new vendors who innovate for open and intelligent RAN. The last category span from HW suppliers who are providing commodity HW, commodity SW platforms, to new Network Function vendors. In addition, a new set of integrators is materializing. This allows for all parts of open RAN to be done by U.S. companies, and Dell Technologies is investing in it.

Open RAN targets to disaggregate RAN in multiple layers and ways:

1. HW/SW disaggregation: Separation of HW, OS/Platform, and Network Functions.
2. Disaggregation of RAN architecture into RU, DU, and CU with multiple deployment options.
3. Cloudification of RAN so that Network Functions can be managed in cloud App fashion.

The diagram below provides the scope of O-RAN Alliance architecture and shows communication and management protocols and APIs for the composable solution.



Open RAN provides flexibility to adopt this general architecture for specific use case, like rural broadband and internet, private mobility, 5G enterprise, etc. In contrast, current 4G LTE using eCPRI only addresses protocol between RU to BBU communication. In most 4G LTE deployments RU and BBU comes from a single vendor that makes it harder to drive down cost, performance, optimization and provide innovation.

Open architecture ensures that each component is interchangeable. As a result, it stimulates innovation from new and existing players to achieve cost savings and healthy ecosystem. However, building new protocols and APIs takes time. The current challenges are that Telecom operators and incumbents NEPs vendors have been emphasizing backward compatibility and legacy architecture, which limiting the progress of new interfaces. Since solutions from disruptors are various, it's slow to reach consensus across community. This is buying more time for incumbents to mature their own virtualized solution, and also make disruptors hesitate to open source their key IP for build a true interoperable architecture. Many industry associations and consortia are contributing to open network efforts towards the same goal. including TIP, ONF, etc.

Open RAN Ecosystem.

Open RAN is a highly flexible, highly scalable architecture that allows mobile operators to deploy RAN and edge infrastructure using virtualized and decentralized components. Open RAN solutions completely change the economics and the time to innovation for 5G network services and enable mobile operators to choose which vendors to deploy in their network while providing more options to scale-out RAN resources where they are needed and in precisely the right amounts.

Open RAN brings game-changing benefits to mobile network operators (MNOs) as they look to build out their 5G networks and create new revenue-generating services. For instance, Open RAN solutions should be just that, open, whether it's supporting open standards or being open to innovative ideas from visionary partners. Open architectures provide operators with options to choose whom they want to work with for the various RAN functions. It gives operators choice and flexibility and provides an attractive path to deploying best-of-breed solutions offered by many innovative RAN players, small or big.

Additionally, time-to-market for new services is critical to 5G revenue generation, but it is vital that RAN vendors support the services customers want to deploy. In effect, the RAN vendor now becomes the chokepoint for innovation, limiting what can be done and when. Open RAN solutions bring a world of innovation to the table beyond traditional telecommunications vendors, allowing MNOs to tap into automation, AI, big data, cloud computing, and more.

While the size and timing to scale solutions will vary by company there are many in the industry investing in Open RAN solutions. However, the lack of direction by the U.S. to invest in these technologies and the unclear market have caused some hesitancy among smaller companies to invest in these efforts. Without optimal business conditions, a clear marketplace, and expendable R&D budgets, small and, to some extent large, companies cannot afford to take the risk to invest in technology where there is no expectation of a customer. As noted in the Notice of Inquiry, many companies, including Dell Technologies, supply critical components of wireless networks and we believe U.S. companies have the capabilities to manufacture other subcomponents, including radios, and with additional government investment could do so at scale. As such, we encourage the U.S. government to make clear indications of the role Open RAN will play in the deployment of 5G moving forward and continue to make funding available for Open RAN solutions.

Domestic and International Deployments.

With the appropriate investment and incentives, the U.S. is capable of large-scale Open RAN deployments in the near future with qualified U.S. vendors. However, in order to deliver an integrated and truly interoperable end-to-end process domestically, there needs to be a pipeline of R&D and industrialization funding for continued development of open and interoperable RAN. Furthermore, focus on U.S. ownership and participation via increased grant opportunities and grant amounts will allow for many of these deployments to be done entirely via domestic

companies. This will also illustrate to smaller companies that there is certainty around the Open RAN market.

Dell Technologies continues to actively support the efforts of the Open RAN movement, including working with the 5G Open RAN Ecosystem and providing essential hardware platform for the NTT O-RAN ecosystem initiative. Open RAN technologies are essential to accelerating the deployment of 5G networks and future technology innovations. As such, increased domestic investment in Open RAN will enable a broad range of technology vendors to bring innovation to the telecom industry and beyond.

On the other hand, operators globally are developing and deploying Open RAN architecture at a far more rapid pace due to support provided by government policies. Regarding 5G development, the United Kingdom and European Union countries have developed programs that support local vendors and in-market 4G/5G solution integration. To maintain competitiveness, the U.S. could use a similar approach to provide U.S.-based compliance/interoperability labs and provide capital expenditure offset for the domestic Open RAN ecosystem. In addition, increased investment would broaden the deployment of Open RAN systems using existing generations of networks in low-income and rural environments. Notably, 5G multi-vendor interoperability and 4G/5G network interoperability could utilize federally funded 4G/5G Open Network and Open RAN interoperability labs.

Potential Public Interest Benefits in Promoting Development and Deployment of Open RAN

Increased Competition and Network Vendor Diversity.

As previously mentioned, open architectures provide operators with options to choose whom they want to work with for the various RAN functions. It gives operators choice and flexibility and provides an attractive path to deploying best-of-breed solutions offered by many innovative RAN players, small or big.

The current ecosystem does not allow for maximum participation or competition in the market. While larger companies can provide equipment and services to the current vendors, the proprietary nature of the solution is a barrier to entry for many smaller companies. These companies are unable to access the standard to design products that can interface with the solutions.

Open RAN has the ability to minimize the costs associated with developing a proprietary end-to-end network or deploying and maintaining single-vendor hardware. With Open RAN and open architecture, the barrier to entry is reduced as businesses build to an industry agreed standard. With multiple vendors able to provide various components, increased competition can reduce costs and theoretically wireless carriers could pass those savings on to the consumer.

Affordability of Services and Products for Consumers.

With increased competition, we anticipate that there would be a decrease in operational costs. Additionally, an Open RAN ecosystem based on modern cloud and IT capabilities would apply the proven cloud, virtualization and software automation capabilities to telecom at scale resulting in similar operational efficiencies the U.S. has already seen in its IT and cloud industries. Such cost savings will eventually be passed on to the consumer by the wireless carriers. Additionally, these savings will make wireless broadband more affordable for rural and low-income Americans.

Network Security and Public Safety.

Domestic investment in Open RAN is one of the key solutions to increasing security threats posed to the U.S. communications supply chain. Moreover, public-private coordination in supply chain security will enable the successful development and deployment of Open RAN infrastructure in the United States.

Telecommunication Network Operators and owners have long understood the value of a failsafe architecture. If a proprietary RAN vendor experiences a supply chain issue or, worse, goes out of business, the alternative isn't as simple as turning to another proprietary RAN vendor. With an Open RAN architecture, Telecommunication Network Operators and owners have more choices and can buy RAN solutions from a wide field of vendors much as they do for compute or storage, which brings us to the supply chain.

Open RAN also allows for companies to innovate and build in additional security, and multiple-vendor participation mitigates security design issues due to the broad innovation network of vendors. The ecosystem of suppliers has an interest in ensuring the security of the standards and the entire ecosystem works to perfect the environment. Everyone pressure tests the architecture and, once a vulnerability is found, suppliers can quickly mitigate with software or via other interoperable components rather than ripping out the entire system.

Potential Technological Benefits of Open RAN Deployment.

Given the constrained vendor ecosystem of traditional telecom, the sources of technology innovation are much smaller in global telecom than other ecosystems such as IT and cloud. With a more open and disaggregated telecom architecture, like Open RAN, the number of technology companies involved would expand and likely include most major U.S. technology vendors. This broad technology ecosystem would revolutionize the innovation environment for global telecom by rapidly applying the collective expertise and innovation of the cloud, IT, semiconductor, enterprise and other U.S. technology ecosystems to evolving 5G to 6G. Dell Technologies is an end-to-end provider in the cloud, IT and many vertical industries that enable our customers across the globe to create remote workforces, secure critical data, and scale without disruption. With policies that encourage companies such as Dell Technologies to invest in 5G and 6G, the technology benefit is not just in executing the current innovation path but would broaden the innovation ecosystem and likely result in both faster innovation and cross-domain innovation

which is usually the most disruptive. These benefits are most likely to be realized with appropriate support from the government.

Artificial Intelligence and Machine Learning.

Artificial Intelligence and Machine Learning (AI/ML) is not unique to Open RAN. However, the use of machine intelligence technologies will be critical to automate the operations of large-scale cellular networks. It is likely that the 5G networks in the U.S. alone will have billions of connected devices attached and at that scale the only viable way to operate is by substantial use of AI/ML. Additionally, the security complexity of 5G and 6G will require AI/ML to operate successfully. Because of the propriety nature of the current wireless systems, it is extremely limiting for outside sources of innovation to apply expertise to solving operational or security challenges of the wireless systems. However, with Open RAN the disaggregated system allows for more targeted interoperable application of AI/ML innovation into the system and the open interfaces allow for visibility into critical protocols and interfaces that produce key insights that advanced AI/ML can use to create new value. The RAN Intelligent Controller (RIC in Open RAN) is an excellent example of this model where via Open Interfaces, an AI driven “brain” can be applied to the Open RAN in a modular and replaceable way to create an entirely new ecosystem of innovation developing a broad set of optional intelligence that can influent and control the underlying multi-vendor Open RAN. The utilization of Open RAN would allow for specialists and those with technical expertise in this field and other emerging technologies to build solutions for advanced communications rather than having solutions built by technology generalists.

Virtualized Operating Environment.

Virtualizing the RAN enables new centralized and decentralized deployment models that provide operators with flexibility regarding where to deploy the distributed unit (DU) and centralized unit (CU). The increased flexibility from virtualized cloud platforms could drastically reduce the cost of building and maintain networks. This allows operators to determine the most cost-effective and scalable deployment models. However, the reduced cost of virtualization has no impact on security and in some regards allows for increased safeguards.

For example, with a virtualized solution, the compute resources can be co-located allowing for security around a centralized point and fewer physical points of entry. It also provides for heightened security than non-virtual solutions by permitting closer management of resources and software. With an IT center control, carriers will be able to quickly detect and correct vulnerabilities as they are discovered and not have to do as many site visits that would be required with the current RAN solutions. Furthermore, as previously mentioned, AI/ML can be used to detect issues more efficiently in a virtualized environment.

Additional Considerations Regarding Open RAN Development and Deployment

Disaggregation/Need for a System Integrator.

In the current ecosystem, integration of the network system is provided mostly by the traditional telecom equipment companies not by vendors providing subcomponents to them. These subcomponents must be integrated at the various interfaces and to the proprietary standard. The difference in an Open RAN environment is that the ecosystem would create new ways to handle the integration of the Open RAN components. These new integrators would need to have expertise in open architectures, work across broader technology areas, and be much more fluent in IT and Cloud Technologies than the existing telecom ecosystem. Many companies, including Dell Technologies, provide this kind of integration for the non-telecom world and with a shift to Open RAN their capabilities could evolve to provide this new integration capability for telecom.

The tech industry has extensive experience in integration and many of our companies work closely with industry and private labs to ensure that products are interoperable. This deployment model also lends itself to a server-based deployment. Dell Technologies believes that more vendors would be able to standardize these components and companies would not have to be locked in with one or two vendors to validate components.

Barriers to Adoption by Established Operators.

Open RAN will benefit both greenfield (new) operators as well as established operators. Open RAN and Core Networks are essential for digital transformation. Closed networks based on an architecture defined more than 20 years ago cannot meet the demands of modern applications, demands and services.

Operators with Open RAN architecture will be able to deliver new differentiated services at higher velocities as compared to operators with closed network architectures. We are an inflection point in the industry where an open network architecture is a prerequisite rather than an option. An API based open architecture has empowered many new business models and disruption in many industries such as transportation, hospitality, etc.

Established telecommunication operators need to have a well-defined evolutionary path to Open RAN architecture. With advent of 5G, they have an opportunity to efficiently evolve to Open RAN architecture without disruptive their legacy network operations. This inflection point in their network evolution is the time to address needs for the next generation of services with Open RAN.

Open RAN will also enable the established operators to reduce their operational costs significantly as they will be able to leverage automation and software defined networking. The total cost of ownership will be lower for the established operators.

Potential Commission Efforts to Promote Development and Deployment

Identify Potential Barriers.

In order to incentivize telecommunication operators to adopt Open RAN technologies, there needs to be direct R&D and industrialization funding. This incentive is crucial to the establishment of a domestic Open RAN ecosystem, trusted U.S. supply chain, and development of future technology innovation. In particular, as discussed above, the following incentives would accelerate the U.S. to build a trusted domestic supply chain: (1) funding based on open, interoperable standards; (2) expansion of a trusted vendor radio equipment supply chain, including manufacturing, through R&D tax credits and other incentive vehicles; (3) expansion of trusted vendors developing open and interoperable RAN technology by utilizing public-private partnerships; (4) increased grant opportunities and grant amounts to qualified U.S. vendors; and (5) design a program to incentivize investment and job creation in the U.S. by offering R&D credits and other incentives for network technology suppliers. While not all in the purview of the Commission, partnership between the FCC and other agencies, such as the Department of Commerce and the Department of Defense, could help inform other efforts to accelerate a more diverse ecosystem.

Additionally, Dell Technologies recommends that the FCC take actions to educate smaller carriers on Open RAN solutions and specifically provide funding for Open RAN solutions in the Commission's various grant programs. Moreover, Dell Technologies encourages the Commission to work with the State Department to help small businesses participate in international standard setting bodies to allow for maximum participation of U.S. companies in these activities.

Testbeds and Demonstration Projects.

The Commission should encourage U.S. companies to develop Open RAN equipment by incentivizing the integration and testing of Open RAN technology through the use of testbeds and other projects. Dell Technologies recommends the creation of additional testbeds in addition to those in New York City and Salt Lake City that would allow for the technology to be tested and verified in other areas such as rural or tribal areas. Additionally, the testbeds should include variations run by wireless carriers themselves as well as municipal broadband projects.

USF/Rip and Replace.

As the FCC and other agencies consider additional steps to enact the Secure Networks Act, Dell Technologies continues to support the need to prioritize domestic technology companies as trusted providers and suppliers—a U.S. company's oversight of the supply and manufacturing ecosystem contributes to both our national and economic security. However, any Rip and Replace efforts should be accompanied with substantial incentive funding to enable providers to participate in the Commission's Reimbursement Program related to Open RAN and other

services. The Commission can offer additional incentives, such as grants through other funding streams, to Reimbursement Program participants who choose to replace their covered equipment or services with Open RAN technology provided by U.S. companies. Moreover, the Universal Service Fund, can be one of the many funding streams the Commission can use to incentivize the development and deployment of Open RAN or virtualized systems.

Currently, U.S. hardware manufacturers are highly reliant on global suppliers for vital components to our telecommunication networks because the U.S. does not have an integrated end-to-end network at scale provider for all components of Open RAN, including 5G networks. Providers' heavy reliance on global entities poses great risk, in part, because providers have little visibility into the viability of their manufacturers and whether they would still be available to service the networks and replace key components years down the road. We recommend the FCC, in coordination with other agencies, mandate the U.S. buildout of Open RAN technologies and future innovative technologies should utilize U.S. managed subsystems and content including computer platforms, virtualization technology, cloud software, networking technology, optical technology, and antenna. This will provide an assessment of existing risks in companies' supply chain and increase visibility as well as allow them to become less reliant on foreign entities. Ultimately, the result is a healthy ecosystem that will provide supply chain security in the years to come.

Operational/Service Rules.

Dell Technologies recommends that the Commission take affirmative action to make clear that Open RAN solutions are available in the current FCC programs.

Commission Outreach and Information Gathering.

Dell Technologies commends the Commission's continued effort to promote stakeholder involvement in Open RAN discussions, including the Commission's Technological Advisory Committee's study of virtualized radio access networks, 5G technology, and Internet of Things applications.

Relationship to Other Federal Agencies.

Dell Technologies recognizes that there may be more than one agency effort to promote and streamline Open RAN development and deployment. We encourage the Commission to coordinate where necessary to ensure there is significant investment to build out our Nation's domestic Open RAN infrastructure.

Role in International Open RAN Efforts.

Dell Technologies supports international coordination to promote the implementation and standardization of open architecture and network virtualization. In particular, the U.S. should work with allies to adopt similar policies including (i) supporting open and interoperable RAN solutions from trusted vendors and service providers with their government funding sources; and

(ii) implementing the widely accepted Prague Proposals that calls for “open, interoperable, secure standards, and industry best practices to promote a vibrant and robust cyber security supply of products and services.” Regarding national research and development efforts, other countries have seen larger increases in their investments in innovative technologies, including in Open RAN. While the domestic effort of to provide research and development funding to educational institutions is necessary and beneficial, there needs to be an equally concerted effort to provide direct R&D and industrialization funding to industry in order to provide large-scale capabilities and build a trusted domestic supply chain.

Conclusion

Dell Technologies appreciates the opportunity to comment on the Commission’s Notice of Inquiry and supports the FCC’s efforts to explore the capabilities and opportunities provided by Open RAN solutions. Dell Technologies believes that after this comment period, the Commission will be able to take additional steps to promote and work with other agencies to incentive the use of Open RAN solutions and create a more diverse ecosystem with U.S. innovation at the center of a secure and reliable communication system.